

**LAURENCIA EPIPHYLLA SP. NOV.
(CERAMIALES, RHODOPHYTA)
FROM THE MEDITERRANEAN SEA**

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ABSTRACT — A new species of *Laurencia* (Ceramiales, Rhodophyta), *L. epiphylla*, is described from the Mediterranean coast of Spain. Distinguishing features include: (i) four vegetative periaxial cells from each axial cell; (ii) main axis usually aborted; (iii) slender, alternately to sub-oppositely branched erect axes; (iv) secondarily pit-connected epidermal cells not radially elongated in branch cross-sections; (v) the presence of lenticular thickenings in the walls of subcortical and medullary cells; and (vi) tetrasporangia borne abaxially and arranged parallel to the stichidial axes. The species is named for its apparently obligate epiphytism on the seagrass *Cymodocea nodosa* (Ucria) Anderson.

RÉSUMÉ — Une nouvelle espèce du genre *Laurencia* (Ceramiales, Rhodophyta), *L. epiphylla*, est décrite de la côte Méditerranéenne de l'Espagne. Cette espèce montre les caractéristiques principales suivantes : (i) quatre cellules périaxiales par segment axial ; (ii) l'axe principal généralement avorté ; (iii) des axes dressés grêles, à ramification alterne ou sub-opposée ; (iv) des cellules épidermiques non allongées en section transversale et présentant, entre elles, des synapses secondaires ; (v) des épaississements lenticulaires sur les parois des cellules médullaires ; (vi) des tétrasporocystes d'origine abaxiale et disposés parallèlement à l'axe des rameaux fertiles. Le nom de cette espèce dérive de son comportement apparemment exclusivement épiphyte sur les feuilles de *Cymodocea nodosa*.

KEY WORDS: marine algae, Ceramiales, *Laurencia epiphylla*, Mediterranean Sea, Rhodomelaceae, Rhodophyta, taxonomy.

INTRODUCTION

Laurencia Lamouroux (1813) is a large cosmopolitan genus that is particularly prominent in warmer seas, where it can be an important component of tropical and subtropical marine floras (McDermid, 1988, 1989). Although most species are epilithic, a few occur exclusively as epiphytes (Saito & Womersley, 1974).

Nam *et al.* (1994), have revised the generic criteria of *Laurencia* and an ancient segregate genus that they resurrect, *Osmundea* Stackhouse (1809). Spermatangial branches in *Osmundea* arise directly from apical and epidermal cells (filament type), whereas in *Laurencia*, they develop from trichoblasts that arise directly from central-axial cells in

apical pits (trichoblast type). Additionally, tetrasporangia in *Osmundea* originate from epidermal cells by a lateral cleavage, while in *Laurencia* they are restricted to periaxial cells. As a result, some *Laurencia* species have been transferred to *Osmundea*, including well-known species present in the Mediterranean Sea such as *O. pinnatifida* (Hudson) Stachhouse, *O. truncata* (Kützinger) Nam et Maggs (as *L. truncata* Kützinger), *O. pelagosae* (Schiffner) Nam (as *L. pelagosae* (Schiffner) Ercegovic), *O. pelagiensis* Furnari and *O. verlaquei* Furnari (as *L. pelagiensis* Cormaci et al. and *L. verlaquei* Cormaci et al., respectively). (Boisset et al., 1995; Cormaci et al. 1994; Furnari & Serio 1993a, 1993b).

At present then, only six *Laurencia* species are confirmed to occur in the western Mediterranean flora: *L. glandulifera* (Kützinger) Kützinger, *L. microcladia* Kützinger, *L. minuta* Vandermeulen, Garbary & Guiry subsp. *scammaccae* Furnari & Cormaci, *L. obtusa* (Hudson) Lamouroux, *L. paniculata* (C. Agardh) J. Agardh, and *L. papillosa* (C. Agardh) Greville (Ballesteros, 1990; Cecere et al. 1996; Cossu et al. 1992; Furnari & Cormaci, 1990; Gallardo et al. 1985; Giaccone et al. 1985; Perret-Boudouresque & Seridi, 1989; Verlaque, 1981). However, the taxonomic treatment of the genus in the Mediterranean Sea is incomplete and a systematical and nomenclatural review is needed for some of this species.

The subject of the present paper is a distinctive species recently collected on the leaves of a seagrass host at subtidal depths from two localities in the Spanish Mediterranean.

MATERIALS AND METHODS



Fig. 1. The Western Mediterranean Sea (inset) and localization of the two collecting sites in eastern Spain of *Laurencia epiphylla* Boisset & Lino, sp. nov. The block arrow indicates the type locality. La Granadella.

Plants were collected by SCUBA on leaves of the seagrass *Cymodocea nodosa* (Ucria) Ascherson, and fixed in 4% formaline in seawater. For microscopic observations, some specimens were stained with 1 % aqueous aniline blue acidified with dilute HCl which enhances pit-connections. Permanent slides were mounted in a mixture of corn syrup and water (25:75). Type and voucher material is held at the Herbarium of the Universidad de Valencia, Departamento de Biología Vegetal (Botánica), Valencia, Spain (VAB-Algae).

Besides the Holotype, Isotype and Paratype collections specified below, the following material was examined and compared: *Laurencia minuscula* Schnetter. Puerto López (Alta Guajira), Colombia, tetrasporophytic and male and female isotypes collected on 22 February 1972 by M.L. Schnetter, Herb. M.L. & R. Schnetter, A-2111.

OBSERVATIONS

Laurencia epiphylla Boisset & Lino sp. ■■ (Figs 2,3)

LATIN DIAGNOSIS. *Thallus gracilis, erectus, epiphyllus, teres, flexibilis, usque ad 20 mm altus; chartae adhaerens; Base discoidea; Axibus principalibus brevissimis, plenum fractis; 2-3(4) axibus secundariis 0.5 mm latis, roseis vel subviridibus, ramulis gracilibus roseis vel rubiginosis; Ramificatio laxa aliquantulum patens, irregulariter alterna vel subopposita. Cellulae corticales, externe visae longitudinaliter elongatae (50-150 × 15-50 µm), prope apicem ramuli non procurentes; connectiones secundariae inter cellulas contiguas praesentes; cellulae in sectione transversali radialiter non elongatae; cellulae interiores crassitudinibus lenticularibus praeditae; tetrasporangia plena matura, dispositione parallela, a cellulis pericentralibus abaxaliter facta; plantae sexuales ignotae.*

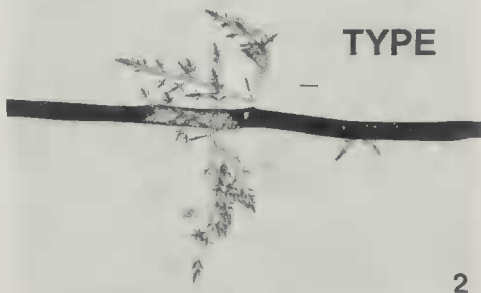


Fig. 2. Holotype specimen of *Laurencia epiphylla* sp. nov. Scale bar = 1mm. VAB-Algae 1434.

DIAGNOSIS. *Thallus growing on leaves, slender, erect, terete and flexible, adhering to paper on drying, to 20 mm in height; holdfast discoid; main axes, very short, usually aborted; first-order laterals 2-3 (-4), 0.5 mm wide; color of axes rose to light green. Apices, branchlets and young branches rose to reddish-brown; branching loose, somewhat patent, irregularly alternate or sub-opposite; superficial cortical cells in surface view 50-150 × 15-50 µm, longitudinally elongate at mid frond, not projecting near apices;*

secondary pit-connections present between epidermal cells; lenticular thickenings present in medullary cells; tetrasporangia abaxial and arranged parallel to stichidial axes; gametophytes unknown.

ETYMOLOGY. The specific epithet refers to the apparently obligate growth of the species on the leaves of a marine angiosperm.



Figs 3, 4. *Laurencia epiphylla* Boisset & Lino, sp. nov. Fig. 3. Wet habit of a tetrasporophyte showing aborted main axis (arrow), two first-order laterals and pattern of branching (VAB-Algae 1435). Scale bar = 2 mm. Fig. 4. Detail of a holdfast showing main axis arrested (arrow) on which two first-order laterals have arisen (VAB-Algae 1438). Scale bar = 500 μ m.

TYPE LOCALITY. La Granadella (Fig. 1), Jávea, Alicante, SE Spain ($38^{\circ}44'N$, $0^{\circ}12'E$).

HOLOTYPE (Fig. 2). VAB-Algae 1434, a tetrasporophyte collected from the seagrass *Cymodocea nodosa* (Ucria) Ascherson at 9–12 m depths by F. Boisset & J.C. Lino on 1 August 1996.

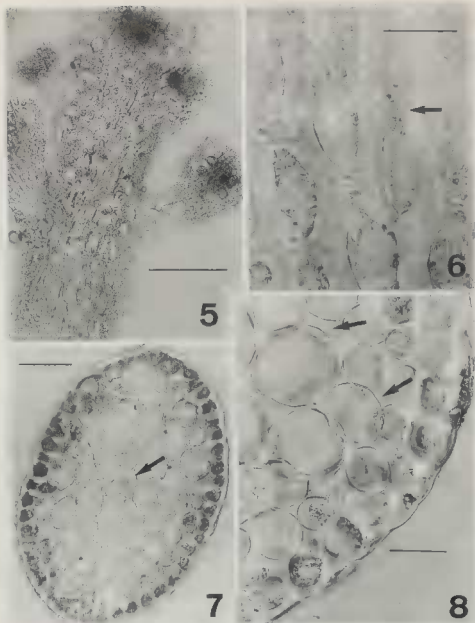
ISOTYPES. VAB-Algae 1433, 1435–1444. Tetrasporophytes collected at the same type locality as the holotype.

PARATYPES. VAB-Algae 1446–1451. Tetrasporophytes collected in Isla de Tabarca, Alicante, Spain at 8–10 m depths by F. Boisset on 26 May 1991.

DISTRIBUTION. Known only from the two collection localities.

HABITAT. Collections were made from 8–12 m depths (most commonly around -10 m) in semi-sheltered seagrass beds of *Cymodocea nodosa* (Uchria) Ascherson. Other components of the epiphyllous flora included *Sphacelaria cirrosa* (Roth) C. Agardh, *Aglaothamnion* sp., *Ceramium tenerrimum* (Mertens) Okamura, *Polysiphonia sphaerocarpa* Borgesen and *Chondria mairei* G. Feldmann. This new *Laurencia* species appears to be seasonal, with plants reaching maximum numbers in summer, rapidly declining from August onward, and being absent from November through June. No thallus were observed growing on leaves of *Posidonia oceanica* Delile.

HABIT. Thalli reach 20 mm in length and consist of one (occasionally two or three) short primary axes arising from a discoid holdfast (Figs 2, 4). Primary axes showing a deciduous distal branchlet, rarely developed in a short main axis. Plants are



Figs 5-8. *Laurencia epiphylla* Boisset & Lino, sp. nov. Fig. 5. Distal end of a second-order lateral showing short branchlets and polygonal superficial cortical cells (VAB-Algae 1433). Scale bar = 500 μ m. Fig. 6. Surface view of longitudinally elongated superficial cortical cells at mid-frond, with the cells linked by secondary pit connections (arrow) (VAB-Algae 1433). Scale bar = 50 μ m. Fig. 7. Transverse section of a primary axis showing a distinct central axial cell (arrow), the medullary cells and cuneate superficial cortical cells (VAB-Algae 1435). Scale bar = 100 μ m. Fig. 8. Cross-section showing rounded superficial cortical cells, subcortical and medullary cells. Note the numerous intercellular spaces (arrows) (VAB-Algae 1438). Scale bar = 30 μ m.

soft; principal axes are rose to light-green in color, with ultimate branchlets and actively growing parts usually reddish-brown. Branching is radial, loosely alternate or subopposite above and patent below. Axes reach up to four orders of ramification. On each main axis, 2-3 (4) of the first-order laterals become indeterminate and form lengthy secondary erect axes, naked in the basal parts (Figs 2,3); these reaching 18 mm in length and 350-500 μm in width. Branchlets terete, radially arranged, to 850 μm long and 250-300 μm wide, distally truncate and basally constricted, and they are deciduous in older axes (Fig. 3).

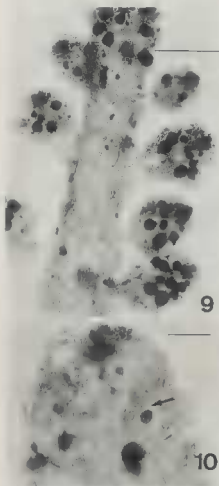
VEGETATIVE STRUCTURE.

Axes grow from apical pits within which the single apical cells and deciduous trichoblasts are located. Central axial cells are each surrounded by four vegetative periaxial cells. Superficial cortical cells at the apices appear irregularly rounded, polygonal or, isodiametric, 12-35 μm in diameter (Fig. 5), not projecting, in surface view. At mid frond, those are longitudinally elongated, 50-150 μm long and 15-50 μm wide, secondarily pit-connected (Fig. 6). Plastids are small, rounded or more irregularly contoured of 3-5 μm in diameter.

Cross-sections of axes in mid-regions show cuneate (Fig. 7) to rounded (Fig. 8) superficial cortical cells, 15-35 $\times$ 25-50 μm , not forming a palisade region of radially elongated cells. Subcortical cells are rounded, 10-50 μm in diameter, whereas those of progressively deeper layers range from 40-80 μm in diameter. Medullary cells are thin walled, rounded or irregularly polygonal 35-100 μm in diameter, with numerous intercellular spaces (Fig. 8). Medullary cells in longitudinal section are subrectangular in profile, 170-225 (250) μm long by 50-65 (90) μm wide. Lenticular thickenings occur in the walls of the subcortical and medullary cells.

REPRODUCTIVE STRUCTURES.

Only tetrasporophytes were found. Tetrasporangia (100-150 μm in diameter) are cut off abaxially from periaxial cells (Fig. 10). They are arranged parallel to the central



Figs 9-10. *Laurencia epiphylla* Boisset & Lino, sp. nov. Fig. 9. General aspect of fertile ultimate branchlets showing the parallel arrangement of tetrasporangia (VAB-Algae 1436). Scale bar = 500 μm . Fig. 10. Longitudinal section of a fertile branchlet showing a tetrasporangial primordium (arrow) being cut off abaxially from a pericentral cell (VAB-Algae 1436). Scale bar = 100 μm .

axial filament within simple or compound, clavate ultimate branchlets that reach 500–1100 µm in length by 300–600 µm in width (Fig. 9).

DISCUSSION

The presence of four vegetative periaxial cells per axial cell, secondary pit-connections between the superficial cortical cells, lenticular thickenings in the subcortical and medullary cells and abaxially initiated tetrasporangia arranged in parallel within the fertile branchlets, place the new species in the subgenus *Laurencia*, section *Forsterianae* (Nam, 1990; Nam & Saito, 1995; Saito, 1967; Saito & Womersley, 1974; Yamada, 1931).

The species that most closely approaches *Laurencia epiphylla* in habit is *L. minuscula* Schnetter (1975), from the Atlantic coast of Colombia. Described as an epiphyte of the seagrass *Thalassia testudinum* Banks ex König, the species differs from *L. epiphylla* by their brownish color, branching frequently subdichotomous, more deeply constricted branch bases and does not consistently display aborted main axes. Furthermore, we have found (pers. obs.) that the surface cells at the apices of *L. minuscula* often project, and at mid-frond these are rounded or slightly ovoid (25–60 × 15–37 µm) but are not so longitudinally elongated as in *L. epiphylla*.

The presence of a deciduous distal branchlet on the short main axis is a character not previously reported in *Laurencia*. Perhaps these deciduous branchlets function as propagules. Our material also shows deciduous branchlets in older axes, a character apparently found in few species of *Laurencia*. (Cruz Adams & Ballantine, 1996; Masuda *et al.*, 1997). As result, mature axes often become denuded in basal and middle regions. No sexual plants have been observed in *L. epiphylla*. The lack of gametophytes is a phenomenon reported by McDermid (1990) in other warm-water species of the genus. We suggest that perhaps in this species, the tetraspores are apomictic and presumably repeat the same generation.

Other diminutive and sometimes epiphytic species of the genus (Table 1) include the widely distributed *Laurencia decumbens* Kützinger (= *L. pygmaea* Weber van Bosse), which differs significantly by its decumbent habit in which prostrate portions secondarily anchor by discoid haptera and the main axes are unilaterally branched (Yamada, 1931; Rodríguez de Ríos & Lobo, 1984; Cribb, 1983; Jaasund, 1976). *Laurencia caribica* Silva (= *L. nana* Howe), lacks secondary pit-connections between epidermal cells and has a right-angle arrangement of tetrasporangia (Taylor, 1960; Ballantine & Norris, 1989). *Laurencia forsteri* (Mertens ex Turner) Greville, a southern Australian species restricted to leaves of the seagrasses *Posidonia* and *Amphibolis*, has larger, more pyramidal thalli, bearing divergent, subdistichously arranged branchlets (Saito & Womersley, 1984). *Laurencia venusta* Yamada (Yamada, 1931; Jaasund, 1976), and *L. tenera* Tseng (Tseng, 1943; Jaasund, 1976), both differs in their turf-forming habit and dichotomous to subdichotomous branching.

In the Mediterranean Sea the only previously described epiphytic *Laurencia* is *L. minuta* Vandermeulen *et al.* (1990), which differs from *L. epiphylla* by its smaller size and clavate thalli (Vandermeulen *et al.*, 1990; Furnari & Cormaci, 1990; Boisset & Aranda, 1991). Like *L. minuta*, *L. epiphylla* appears as a opportunistic species, with a maximum development in summer on the new year leaves of *Cymodocea nodosa*. We continue monitoring the populations of *L. epiphylla* to better understand their reproductive biology and phenology.

Tabl. 1. Comparison of *Laurencia epiphylla* sp. nov. with other small species of *Laurencia*.

Taxa	Habit	Cortical cells	Lenticular thickenings	Tetrasporangial arrangement
<i>Laurencia caraibica</i> Silva	— occasionally epiphytic ? — caespitose, to 2 cm high — dichotomous or subdichotomous branching — presence of coalesced branches	— regularly rounded-hexagonal with thick cell walls — 2° pit-connections absent	— occasional	— right-angle
<i>Laurencia decumbens</i> Kützinger	— frequently epiphytic — creeping thallus, decumbent, to 2 cm high — secund branching	— rounded-polygonal to elliptical — 2° pit-connections present — sometimes projecting	— present	— parallel
<i>Laurencia epiphylla</i> sp. nov.	— epiphytic on <i>Cymodocea</i> leaves — to 20 mm high — discoid holdfast — aborted main axis with deciduous distal branchlet — alternate to subopposite branching	— longitudinally elongate at mid frond — 2° pit-connections present — non-projecting	— present	— parallel
<i>Laurencia forsteri</i> (Mertens ex Turner) Greville	— epiphytic on <i>Posidonia</i> (or <i>Amphibolis</i>) leaves — larger, pyramidal thalli, to 8 cm high — discoid holdfast — subdichotomous branching	— longitudinally elongate at mid frond — 2° pit-connections present — non-projecting	— present	— parallel
<i>Laurencia minuscula</i> Schnetter	— epiphytic on <i>Thalassia</i> leaves — to 1.3 cm high — discoid holdfast — frequently subdichotomous branching	— rounded or slightly ovoid at mid-frond — 2° pit-connections present — slightly projecting	— present	— parallel
<i>Laurencia minuta</i> Vandermeulen, Garbary & Guiry	— epiphytic, clavate, mostly unbranched, to 3.5 mm high — discoid holdfast	— polygonal, generally isodiametric — 2° pit-connections present — non-projecting	— absent or present (in ssp. <i>scammaccae</i>)	— parallel
<i>Laurencia tenera</i> Tseng	— intricate, to 1 cm high — discoidal haptera and secondary holdfast — dichotomous to subdichotomous branching — presence of coalesced branches	— irregularly polygonal to elongated longitudinally, with thin cell walls — non-projecting	— absent	— parallel
<i>Laurencia vemusta</i> Yamada	— intricate, to 10 cm high — dichotomous to subdichotomous branching — final branches predominantly in whorls of 3	— mostly rounded-polygonal, occasionally longitudinally elongate — 2° pit-connections present — slightly projecting	— present, annular	— parallel

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